

Caprine Arthritis Encephalitis Virus



Figure 1. Could the weight loss and rear limb weakness in this goat be due to CAEV?

What is caprine arthritis encephalitis?

Caprine arthritis encephalitis is a viral disease of goats that is caused by the caprine arthritis encephalitis virus (CAEV). CAEV is a lentivirus, and one of several lentiviruses in the family Retroviridae. Other retroviruses are human immunodeficiency virus, which causes AIDS in humans; maedi-visna virus of sheep; bovine leukosis virus of cows; avian leukosis virus of chickens; and simian immunodeficiency virus of monkeys.

What diseases are caused by CAEV?

The multisystem diseases caused by CAEV infection are: arthritis, pneumonia, mastitis, weight loss (all of which are more common in does and bucks), and encephalitis (more common in kids).

What are some clinical signs that a herd may be affected by CAEV?

A high percentage of CAEV-infected goats will not become symptomatic. For those goats that do become symptomatic, the clinical signs of CAEV infection vary, depending on the type of disease that is present. Arthritis is common in sexually mature goats. Goats will become lame either suddenly or more slowly, and the lameness will

become progressively worse. The knee joints or carpal joints will become distended. Goats will lose body condition and develop a rough hair coat, which may be due in part to decreased competitiveness at the feed bunk. Labored breathing due to pneumonia may be present in both mature goats and kids. The mastitis is referred to as “indurative mastitis” due to the deposition of vast quantities of connective tissue in the udder as part of the immune response. During and after the kidding period, the udder will be firm and swollen, hence the term “hard udder.” Milk production will be low or completely absent. In a recent study of CAEV infection in a Pässeierer Gebirgsziege goat herd in Germany, weight loss was one of the most common signs.



Figure 2. Swollen knee joints and paralysis, typical of a goat affected by CAEV.

Are the clinical signs different in kids versus mature goats?

Yes. Encephalomyelitis, inflammation of the tissues in the brain and brain stem, is common in kids 2 to 4 months old. Initially, affected kids will be lame, the gait will be wobbly and misdirected, and correct placement of the hind limbs and feet will become difficult. As the disease progresses, paralysis of both limbs on one side of the body, or paralysis of all four limbs will occur. Standing will become impossible, so the goats may lie on their sides and paddle in the bedding. Other signs are depression, walking in circles, head twitch, head tilt, exaggerated upward tilt of the head, exaggerated sideward tilt of the head, and muscle tremors.



Figure 3. A young goat pressing its head against the wall, typical of a kid with encephalomyelitis caused by CAEV.

Can goats rid themselves of CAEV infection?

No. CAEV infections are persistent; they are life-long infections. After a goat becomes infected, it will always be infected, although the extent to which goats shed CAEV virus may not be constant during the infection.

Is CAEV infection widespread?

There is substantial evidence that CAEV infection is widespread in the United States and in some foreign countries. Evidence of CAEV infection has been found wherever it has been sought, although the prevalence of the infection varies substantially among countries. CAEV was described first in the United States around 1980. Shortly thereafter, evidence of CAEV was found in other developed countries in Europe. Recently, there have been reports of CAEV infection in developing countries. CAEV was reported for the first time in Japan during 2004, and it was reported for the first time in Jordan during 2005.

Economically speaking, why should goat producers be concerned about CAEV?

CAEV certainly adversely affects the health of goats. The quality of life in animals with signs of disease is decreased due to pain and disability. The extent to which it may adversely affect productivity is not as clear. Swiss goat producers reported that 5 to 10 percent of their goat population is culled annually due to arthritis, and the decrease in milk production in infected does was estimated to be 10 to 15 percent. Milk production, protein, fat, lactose and somatic cell counts were compared for seropositive and seronegative goats of similar ages in Norway. There were 1,799 goats from 66 herds included in

this study. The values for infected and non-infected goats were similar. The one difference was that the somatic cell counts of 2-year-old infected goats were higher than the counts of 1-year-old infected goats. CAEV infection did not increase intramammary bacterial infections in Murcia-Granada goat herds in Spain, when herds with low prevalence of CAEV infection were studied. Loss of genetic merit was the greatest loss in a herd of Pässeirer Gebirgsziege goats in Germany during 1997–1999.

Are there breeds of goats that are more susceptible than other breeds to CAEV infection?

Because no vaccines against CAEV have ever been available commercially, an alternative method of control that should be considered is CAEV-resistant breeds of goats. There is some evidence that Bedouin black goats in Israel are resistant to CAEV infection. The results of a survey of infection in 10 herds showed that CAEV antibodies were rare in Bedouin black goats, but antibodies were much more common in Saanen members of the same herds. The Saanen goats had been imported. A similar circumstance exists in sheep: the native Israeli Awassi breed, although susceptible to ovine lentivirus infection, does not develop clinical disease to which the CAEV-infected European breeds of sheep are so susceptible. These findings suggest that CAEV infection may be controllable by expanding resistant breeds, or by introducing the genes that are responsible for disease resistance.

What is the primary route of transmission of CAEV among goats?

The major route of transmission of CAEV is consumption of virus-infected colostrum or milk from infected does. This is a natural route of transmission from does to kids, and it is a highly efficient route.

Are there routes of transmission to kids other than colostrum and milk?

Not all CAEV infection in kids can be explained by ingestion of CAEV in milk. There are other potential routes of transmission that are not as efficient as colostrum and milk transmission. These potential routes are *in utero* transmission, birthing transmission, transmission via saliva and respiratory secretions during mothering, and accidental ingestion of colostrum from CAEV-infected does. The evidence to support perinatal routes of transmission is not as strong as the evidence for transmission via milk and colostrum.

Can infected does transmit CAEV to their unborn kids (i.e., is prenatal transmission possible?)

There have been a series of attempts to find evidence to support prenatal transmission of CAEV, but finding that evidence has been challenging. In a recent study, CAEV-infected cells were found in tissues along the entire length of the reproductive tract of does, including the oviduct, ovary, uterus, associated lymph nodes, and post-partum genital secretions. This strongly supports the possibility of prenatal transmission of CAEV. The current belief is that no more than 5 to 10 percent of kids may be born with CAEV infection.

What routes of transmission are of concern to mature goats?

During the day-to-day management of mature goats, there are a number of routes of transmission that may be important. Several of these are related to the commingling that takes place in high-density goat herds such as dairies. Milking machines, contaminated hands and hand towels, leaky udders, contaminated tools (such as needles, tattoo tools and dehorning tools), estrous mucus, prepuce mucus, semen, and saliva and nasal secretions from bucks should not be ignored by producers, although clear-cut evidence of transmission via these routes has not been established. Of 14 dairy goat herds that were studied in New South Wales, the herd with the greatest number of new infections was a herd with the greatest stocking density, no control measures, deep litter as the sole bedding, contamination of feed and water with feces, frequent introduction of newly purchased animals, and unrestricted use of tattoo, drench, and vaccination tools.

Can CAEV be transmitted in semen?

CAEV was isolated from parts of the semen of experimentally infected bucks in 1998. However, it must be emphasized that the infection in these bucks was experimental, not natural. One year later in 1999, it was shown that semen from naturally infected bucks can become contaminated with CAEV. At the present time, there is no evidence that bucks will transmit the infection to does via the semen, but an appropriate level of caution must be taken by producers when using natural or assisted reproduction with semen from seropositive bucks. As pointed out earlier, transmission between bucks and does may take place by routes other than by semen, and those routes of transmission (e.g., close contact) may lead to more new infections than the semen route.



Figure 4. Can semen from this buck be contaminated with CAEV?

What is one of the most important determinants of dispersion of transmission of CAEV from one herd to another?

Live animal trade is an important determinant. Live animal trade is thought to be a major risk factor for movement of CAEV from one herd to another.

Does live animal trade play a role in movement of CAEV infection among countries?

The live animal trade also is a major risk factor for dispersion of CAEV among large geographical regions. A severe outbreak of CAEV occurred in a herd of French Alpine goats in Spain in 1984. This herd, which had been imported from France, was culled to minimize spread of the infection. During early investigations of CAEV prevalence in the Mexican states of Guanajuato and México, it was learned that all the infected goats had been imported from the United States. During a recent investigation of CAEV prevalence in Yucatán, Mexico, it was learned that all the infected goats had been imported from the neighboring Mexican state of Campeche, or from the United States. The indigenous goats of the Criollo breed were not infected.

Numerous goats were imported from France to Poland during the 1990s. Investigation of CAEV in

one Polish herd containing French imports showed that 75 percent of the imported goats were positive whereas the average prevalence in goat herds that were native to Poland was only 15 percent.

Can domesticated ruminants (e.g., sheep, cattle) other than goats become infected with CAEV, and are these ruminants important in transmission of the virus?

Originally, there was no evidence that cross-species transmission of CAEV could occur, except during laboratory experiments. Natural transmission was thought to be unlikely. This school of thought now has been revised. During the past 10 years, cumulative evidence suggests that CAEV can infect sheep, and there is more evidence that the lentivirus of sheep can infect goats naturally. The routes of cross-species transmission are ingestion of virus-contaminated colostrum or milk and direct contact between goats and sheep in densely stocked barns. The discovery that cross-species transmission of goat and sheep lentiviruses is very possible is important for producers who raise both species. When a control program for one species is being designed, the mere presence of the other species and its potential to transmit the infection should be of utmost importance.

Are wild ruminants susceptible to CAEV?

The moufflon, the ibex, and the chamois are three wild ruminant species that are closely related to domesticated goats and sheep. Evidence of a lentivirus has been found in these species, but this lentivirus does not appear to be the same as the lentiviruses of our domesticated goats and sheep. These viruses are not a concern for our domesticated goats and sheep at this time.

What can be done to minimize the transmission of CAEV to uninfected goats?

The underlying basis of most, if not all, CAEV control programs is prevention of vertical transmission first, followed by prevention of horizontal transmission. Prevention of vertical transmission refers to prevention of transmission from doe to kid(s), as an example. Prevention of horizontal transmission refers to prevention of doe-to-doe and kid-to-kid transmission. Preventing kids from nursing infected does and providing the kids with virus-free colostrum and milk prevents vertical transmission. There are a number of biosecurity practices that are recommended to prevent horizontal transmission. First, the producer and veterinarian should design a farm-tailored or herd-specific serological surveillance program. Any seropositive animals should be segregated or culled. Seronegative does should be milked prior to

milking seropositive does. Young does should be milked prior to milking does that are more mature. Seronegative does should be bred to seronegative bucks only, if possible. Appropriate measures of hygiene should be adopted consistently to minimize accidental transmission of virus by needles, dehorning tools, tattoo tools, hoof shears and similar equipment. Greater details about the design of control programs are available from several sources.¹

Are there CAEV control and eradication programs in foreign countries?

CAEV eradication in Switzerland began voluntarily in 1984 when it was recognized that the seroprevalence was 60 percent to 80 percent. "CAE-free" status has been recognized legally since 1998. Seroprevalence has decreased to nearly 1 percent, and the signs of this disease are rare now. CAEV was reported first in New Zealand in 1982. A request from the goat industry to the government led to a voluntary program to establish accredited CAEV-free herds. Although the eradication program was declared a success during its duration, interest on the part of producers waned because the financial reward was perceived to be marginal. An eradication program involving 363 herds and 11,059 goats was undertaken in France during years 1988 to 1990. The emphasis of the program was to protect female kids by designing a personalized program for each producer. However, providing disease-free colostrum and milk, and separating virus-infected from virus-free kids was common among all herds. The prevalence of infection in the kids decreased from 49.5 percent to 25 percent during the two years, and ". . . carpal arthritis nearly disappeared."

Has CAEV ever been eradicated from a herd using strategies that were specific for the herd?

Yes. One of the most recent examples of eradication of CAEV involved the goat herd at the Agricultural University of Norway. The original herd in which the initial prevalence was 97 percent consisted of nearly 100 does of the Norwegian breed. The eradication program was established in late 1993 prior to the December-to-June kidding season, and was continued during years 1994 and 1995. The eradication procedures included diagnostic testing followed by removal of infected animals; disinfection and temporary removal of animals from the premises; separation of newborn kids from their does; feeding cow's colostrum, milk, and milk replacer; establishing separate pastures for rearing young goats; and other biosecurity practices. After testing 230 goats during the 36-

month duration of the program, the herd was declared free of CAEV.

What is the COST program for control of CAEV in Europe?

COST is “European Cooperation in the field of Scientific and Technical Research.” COST is a network of laboratories from 16 European countries that coordinates efforts to eradicate CAEV from the European Union. A four-stage program leading to eradication of CAEV was developed; the first stage was for each country to determine the prevalence of CAEV using large surveys. Also, one recommendation was to maintain the gene pool of the goat breeds in Europe. The roles and responsibilities of a national reference laboratory, individual herds and countries participating in the control program, and the EU were defined by COST.

Does the United States have a COST program similar to that of the EU?

No, there is no similar program in the United States. However the USDA’s National Animal Health Monitoring System will be conducting a national survey of the United States goat population in 2009. NAHMS Goat 2009 will be the first national survey of the health of the goat population in the United States by the USDA. One goal of NAHMS Goat 2009 will be to determine national prevalence of CAEV in the United States. The results of NAHMS Goat 2009 may determine the direction that the United States goat industry will take to control CAEV in the United States. Those goat producers who will be asked to participate in this survey are encouraged to support their industry by becoming involved.

Are there vaccines for CAEV?

The efforts to develop a vaccine against CAEV have been weakly successful at best. A high antibody response to killed CAEV virus was induced in goats in one investigation during the 1990s, but the antibodies did not protect against arthritis. No CAEV-neutralizing antibodies were detected in any of the goats. Vaccine trials by other investigators yielded similar results. Generally speaking, experimental vaccination against CAEV has not been proven to be beneficial. Hence, there are no commercially available vaccines against CAEV almost 30 years after discovery of this virus.

What laboratory tests are available to diagnose CAEV?

The efforts to develop accurate and reasonably priced diagnostic tests for CAEV have been intensive. The first test was the agar gel

immunodiffusion (AGID) test, and it was available for several decades. Additional tests that are available to detect CAEV antibodies are the enzyme-linked immunosorbent assay (ELISA), Western blot, and radioimmunoassay. At least two ELISAs are available commercially from United States companies. Virus isolation is used to detect CAEV virus specifically, rather than CAEV antibodies, and has been available for decades, just as the AGID test has been available. There have been numerous attempts to develop polymerase chain reaction (PCR) applications to detect the virus, but the results have not been consistent. Producers should consult their local private veterinary practitioner for assistance with laboratories that will provide diagnostic services for CAEV.

Are humans susceptible to CAEV infection? Is CAEV important to human health?

Humans are not susceptible to CAEV infection. The one lentivirus to which humans are clearly susceptible is human immunodeficiency virus (HIV), or the AIDS virus, but CAEV and HIV are not the same lentiviruses. Although humans are not susceptible to CAEV infection, goat producers should be aware of the increasing demand by consumers that their products should be derived from food animals with impeccable health status. CAEV and other lentivirus infections of animals may become a major concern to the public for that reason.

Reference:

1. Rowe, J.D.; East, N.E. Risk factors for transmission and methods of control of caprine arthritis-encephalitis virus infection. In: Johnson, R.; Pelzer, K. *Veterinary Clinics of North America: Food Animal Practice*, v. 13(1), p. 35–53.

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